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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04J 3/02 — A1

(11) International Publication Number: WO 97/12456

(43) International Publication Date: 3 April 1997 (03.04.97)

(21) International Application Number: PCT/US96/15598

(22) International Filing Date: 24 September 1996 (24.09.96)

(30) Priority Data:
08/533,709 26 September 1995 (26.09.95) US

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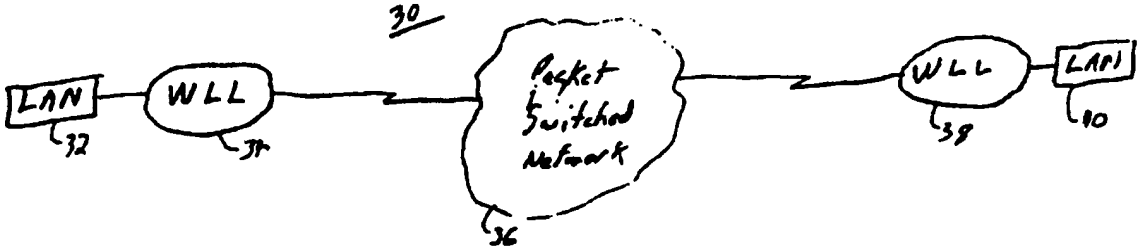
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: COMMUNICATION NETWORK



(57) Abstract

A communication network (30) for connecting widely separated computers (136), local area networks (32) and cable television system subscribers includes a wireless local loop (34) for connecting to a packet switched network (36). A router (86) directs data traffic destined for an address outside a LAN (80) to a transceiver (88). The transceiver (88) transfers the data through the airwaves to a second transceiver (100). A coder-decoder (108), coupled to the second transceiver (100), digitizes any analog data from the LAN (80). A second router (112), connected to the coder-decoder (108), directs the data to one of a plurality of digital switch units (114). The digital switch unit (114) provides clocking and a carrier for the data and passes the data to a frame relay access device (116) that forms frames of the appropriate format for the frame relay network (104).

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COMMUNICATION NETWORK

Field of the Invention

The present invention relates generally to field of computer communications and more specifically to communication networks.

Background of the Invention

The process of connecting computers to communicate is called networking. Networking often requires connecting different computers, running different operating systems together. The International Standards Organization (ISO) developed a model to facilitate this process. The OSI (open systems interconnection) reference model, shown in FIG. 1, attempts to compartmentalize various functions necessary for a network to operate. This compartmentalization allows programmers and engineers to concentrate on their application without being concerned with the operations occurring at the other layers (compartments) in the network. The OSI model 10 consists of seven layers, 1) the physical layer 12, 2) the data link layer 14, 3) the network layer 16, 4) the transport layer 18, 5) the session layer 20, 6) the presentation layer 22 and 7) the application layer 24. The applications discussed herein will mainly be concerned with OSI layers 2 through 5. A number of the protocols discussed herein are only concerned with certain layers of the OSI model and because of the compartmentalization can be mixed and matched.

The increasing power and prevalence of personal computers are increasing the need to interconnect these computers. It is now common for even small offices to have a local area network to connect the office computers to send email, share files and printers. Local area networks only allow communication between computers that are separated by short distances (>1 km). Other solutions are required for a company that wants to share computer information between offices

that are widely separated.

One solution is for a company to lease a dedicated phone line(s) and set up a dedicated wide area network to connect widely separated offices. Generally, a company will lease an ISDN or T1 line from a local bell operating company. In addition, the company may have to lease an ISDN line from their long distance carrier. By leasing a phone line and adding some equipment to connect the company's local area networks to the phone line, two of the company's offices can share computer data. However, a dedicated wide area network is a very expensive operation often costing several thousand dollars a month. In addition it is very inflexible. If the company opens another office and wants the new office's local area network to be connected to the other offices, the company has to at least lease another phone line.

Another solution is for the company to use the internet (world wide web) as a public (shared) wide area network. This requires the company either to sign up with a dial up internet provider or to set up an internet node. The dial up service provides flexibility allowing the company to easily connect and disconnect locations. However, the company will have to pay a time usage charge and the dial up service will not provide a constant or immediate connection between remote locations.

Setting up an internet node requires the company to lease a phone line (ISDN) and to have special internet handling equipment. This may save some of the leasing costs of a dedicated wide area network but is still very expensive. In addition, the company's wide area network is shared which poses certain security concerns.

Thus there is need a low cost and flexible system for connecting widely separated local area networks or individual computers.

Summary of the Invention

A communications network that solves these problems and provides additional benefits includes a local area network coupled to a wireless local loop. The wireless local loop couples to a packet switched network.

Brief Description of the Drawings

FIG.1 is a schematic diagram of an OSI reference model;

FIG. 2 is a schematic diagram of a communication network according to the invention;

FIG. 3 is a schematic diagram of an alternative communication network according to the invention;

FIG. 4 is a schematic diagram of an alternative communication network according to the invention;

FIG. 5 is a block diagram of a local area network (LAN) and part of a wireless local loop;

FIG. 6 is a block diagram of the connection between the LAN and a packet switched network;

FIG. 7 is a block diagram of part of the wireless local loop; and

FIG. 8 is a block diagram of cable television system connected to a world wide web.

Detailed Description of the Drawings

The present invention provides a flexible, constant connection communication network to connect computers (local area networks) separated by large distances, at a reasonable cost. FIG. 2 shows a schematic diagram of one version of a communication network 30 that provides these benefits. A local area network (LAN) 32, such as those found in offices throughout the world, is connected to a wireless local loop 34. The wireless local loop 34 provides the connection between the LAN 32 and a packet switched network 36. The packet

switched network 36 provides the long haul communications transport. The packet switched network 36 is connected to a second wireless local loop 38, that provides the connection to a second local area network (LAN) 40. The wireless local loops 34, 38 allow the company to bypass the local Bell operating companies. Thus saving the cost of leasing a telephone line to reach the packet switched network 36. The packet switched network 36 allows the company to use a non-dedicated long haul resource. Thus the company only has to pay for the amount of bandwidth in actually needs and uses instead of having to pay for bandwidth in fixed increments. In addition, the packet switching network is a logical connection allowing data packets to be delivered anywhere instead of between two fixed points.

FIG. 3 is another embodiment of the invention. A communication network 50 has a cable television system (CATV) 52 connected to a packet switched network 54. The packet switched network 54 is then connected to a wireless local loop 56 that in turn is connected to a local area network 58. FIG. 3 differs from FIG. 2 in that the LAN 32 and wireless local loop 34 are replaced by a cable television system CATV 52. This embodiment takes advantage of the unused spectrum in the CATV system 52 to implement a local area network on the cable plant of the CATV system 52.

FIG. 4 shows another embodiment of a communication network 60. This embodiment shows a first LAN 62 coupled through a wireless local loop 64 to a point of presence (POP) 66. In the other embodiments the POP was integrated into the wireless local loop. A CATV system 68 also connects to the POP 66. The POP is just a local connection point into a packet switched network 70. On the other end of the packet switched network 70 is a second wireless local loop 72. The second wireless local loop 72 is connected to a second LAN 74 and a second CATV system 76. This embodiment shows that the system can have both a CATV system and LAN multiplexed onto the packet switched network, from the same locale. In addition, it shows that the CATV may have to go through a wireless local loop to reach the packet switched network. The packet switched network

could be an asynchronous transfer mode (ATM) network, a frame relay network, X.25 network or any other packet switched network. Many other variations will be apparent to those skilled in the art.

A more detailed diagram of the LAN and connection to the wireless local loop is shown in FIG. 5. The LAN 80 has a number of peers 82 all connected to a cable 84. The peers could be computers, printers or other network devices. The LAN 80 in the preferred embodiment conforms to the ethernet protocol for OSI layers one and two. At OSI layers three and four the LAN 80 preferably conforms to the transmission control protocol and internet addressing protocol (TCP/IP). However, the communication network can handle LANs operating any of a number layer three and four protocols, such as Apple Talk, Net Bios, Net Beau, IPX/SPX (Novell), or Vines IP. A router 86 is also connected to the LAN 80. The router 86 directs frames of data to a transceiver (microwave transceiver or first transceiver) 88, if the frame of data is addressed to a terminal outside of the LAN 80. Besides directing the frame of data, the router 86 converts the data to the TCP/IP protocol if a different protocol is used on the LAN 80. If the wireless local loop is using a wireless T1 or E1 standard, the router 86 may also reformat the data for T1 or E1 transmission. T1 is a digital telephone standard and comprises 24 - 64 Kbps telephone lines. E1 is the European equivalent of T1 and operates at 2.048 Mbps. The transceiver 88 modulates the data for transmission over airwaves.

FIG. 6 is a more detailed block diagram of the connection from a second transceiver 100 of the wireless local loop 102 to a packet switched network 104. Two paths are shown leading from the second transceiver 102. The primary path is through a frame relay network 104. The secondary path is through a world wide web 106. Both the frame relay network 104 and the world wide web 106 are packet switched networks. If the frame relay network 104 sends a message that a path is congested, or that it has lost a packet, the transceiver 100 sends the data along the secondary path through the world wide web 106. The primary path has a coder-decoder (CODEC) 108 connected to the second transceiver 100. The

CODEC 108 digitizes any analog data that has been sent from the LAN 110 to the second transceiver 100. In addition, the CODEC 108 inserts error correcting coding into the data stream. A router (second router or gateway) 112, connected to the CODEC 108, sends the data packets in the direction of their ultimate destination. In one embodiment the router 112 also translates the TCP/IP protocol to a user datagram packet (UDP) protocol. A digital switch unit 114, connected to the router 112, provides the appropriate clock and carrier for the frame relay network 104. A frame relay access device (FRAD) 116, connected to the digital switch unit 114, forms up the frames into appropriate packet sizes for transmission over frame relay network 104. The frame relay network 104 has variable data packet sizes up to a maximum size. The data packet is contained in a FRAD packet having a fixed frame size, for instance 53 byte frames. Other frame sizes are also possible, such as 64 byte frames. Ethernet operates on variable frame sizes. The FRAD 116 forms up frames for transmission over the frame relay network 104 by adding extra bytes to fill up the data packets and adding headers containing control information. The frame relay network 104 is a connection based system and requires acknowledgment signals periodically from the destination address to continue sending frames to the address. The FRAD 116 used in the invention has been modified to insert a false acknowledgment signal, 7E or seven easy, at the beginning and end of any data stream sent to the same destination. As a result the frame relay network 104 allows the data stream to be sent all at once instead of waiting for acknowledgments from the destination address.

The second path from the transceiver 100 leads to the world wide web (internet) 106. A CODEC 118 is connected to the transceiver 100 and also to a multiplexer/demultiplexer 120. The multiplexer/demultiplexer 120 connects to a digital switch unit 122, that is coupled to the world wide web 106. This path is only used when the frame relay network indicates that it is congested, losing packets or inoperable. Since the data follows the TCP/IP protocol it can easily be sent over the world wide web 106 and thus provides a backup system for the

company's private wide area network.

FIG. 7 shows an alternative embodiment, in which both a cable television system and a LAN are connected through the same local access point. The second transceiver 100 receives and transmits data from a LAN. The second transceiver 100 couples to the CODEC 108 and follows the same path as the primary path in FIG. 6. The CATV system connects to an ethernet frequency translator (modem) 130, that demodulates the radio frequency modulated data and passes baseband data onto a CODEC 132. The CODEC 132 performs the same functions as the CODEC 108 in the primary path of FIG. 6. The CODEC then connects to the router 112.

FIG. 8 shows another embodiment, where the CATV system 134 is just connected to the world wide web 106. This figure shows how a CATV system 134 can be configured to provide broadband access to the internet 106. A unique feature of this system is that computer 136 at the user end of the CATV system 134 is always connected to the internet 106, much like a computer in a corporation is connected to the internal LAN. This allows the user to receive email as soon as it is delivered, instead of having to dial up a service to receive email or other services. The computer has an ethernet access card 138 that connects through a cable modem 140 to the cable plant. A pair of unused frequency bands (6 MHZ) is set aside in the cable system for a broad band ethernet network. The data sent outside the CATV system first passes through a CATV headend 140. The CATV headend 140 is where the television signals are received and formatted for transmission (broadcast) to the subscribers. A modem (ethernet frequency translator) 130 is connected to the cable head end 140. A router 112 connects from the modem 130 to the multiplexer/demultiplexer 120 and then to the digital switch unit 112. The digital switch unit connects to the world wide web (internet) 106.

There has been described a unique communication network for connecting computers or LANs that are widely separated. The communication network provides a flexible, virtual wide area network, making it economical to connect

even one computer to the company's network. In addition, the system eliminates the dedicated telephone line leasing costs for both local access and long distance. As a result, the communication network is significantly less expensive for a company to operate. The communication network can also allow a subscriber of a CATV system to access the internet or to create a virtual wide area network.

While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended the invention embrace all such alternatives, modifications, and variations as fall within the spirit and broad scope of the appended claims.

CLAIMS

What is claimed is:

1. A data communications network comprising:

a local area network;

a wireless local loop coupled to the local area network; and

a packet network coupled to the wireless local loop.

2. The data communications network of claim 1, wherein the wireless local loop conforms to a (transmission control protocol/internet control) TCP/IP transmission and addressing protocol.

3. The data communications network of claim 1, wherein the packet network conforms to a TCP/IP transmission and addressing protocol.

4. The data communications network of claim 1, wherein the packet network conforms to a UDP transmission and addressing protocol.

5. The data communications network of claim 1, wherein the wireless local loop conforms to an ethernet protocol.

6. The data communications network of claim 1, wherein the wireless local loop is a wireless T1/E1 channel.

7. The data communications network of claim 1, further including a coder-decoder (CODEC) connected to the wireless local loop.

8. The data communications network of claim 7, further including a router connected to the COCEC.

9. The data communications network of claim 8, further including a digital switch unit connected to the router.

10. The data communication network of claim 9, further including a frame relay access device connected to the digital switch unit.

11. The data communication network of claim 9, wherein the frame relay access device inserts an acknowledgment signal at the beginning and end of a data stream.

12. The data communication network of claim 1, wherein the local area network conforms to an ethernet protocol.

13. The data communication network of claim 1, wherein the local area network conforms to a TCP/IP protocol.

14. The data communication network of claim 1, wherein the local area network is implement on a cable television system.

15. The data communication network of claim 1, wherein the wireless local loop comprises a first microwave transceiver, coupled to a router in the local area network, and is in wireless communication with a second microwave transceiver.

16. A communications network comprising:

a cable television system having a headend and a user end, wherein the user end is connected to a computer through a network card coupled to a cable modem;

a modem connected to the headend of the cable television system;

a router connected to the modem; and

a world wide web coupled to the router.

17. The communications network of claim 16, further including a multiplexer/demultiplexer connected between the router and the world wide web.

18. The communications network of claim 16, wherein the cable television system has a channel for broadband ethernet data.

19. A communications network comprising:

a first local area network;

a wireless local loop coupled to the first local area network;

a packet switched network coupled to the wireless local loop; and

a second local area network coupled to the packet switched network.

20. The communications network of claim 19, wherein the first local area network conforms to a TCP/IP protocol.

21. The communications network of claim 19, wherein the first local area network includes a router coupled to the wireless local loop.

22. The communications network of claim 21, wherein the wireless local loop has a first transceiver coupled to the router, in the first local area network, and is in wireless communication with a second transceiver.

23. The communications network of claim 22, wherein the second transceiver is coupled to a second router.

24. The communications network of claim 23, wherein the second router

is coupled to a frame relay access device that is coupled to the packed switched network.

25. The communications network of claim 19, wherein the packet switched network is a frame relay network.

26. The communications network of claim 19, wherein the packet switched network is a world wide web.

27. The communications network of claim 19, wherein the second local area network is a cable television system.

28. The communications network of claim 27, further including an ethernet translator coupled to the cable television system and coupled to the packet switched network.

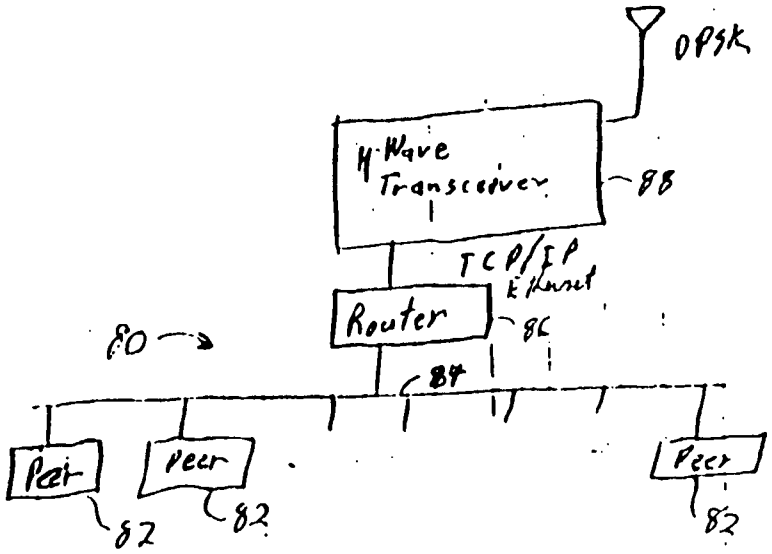

FIG. 5

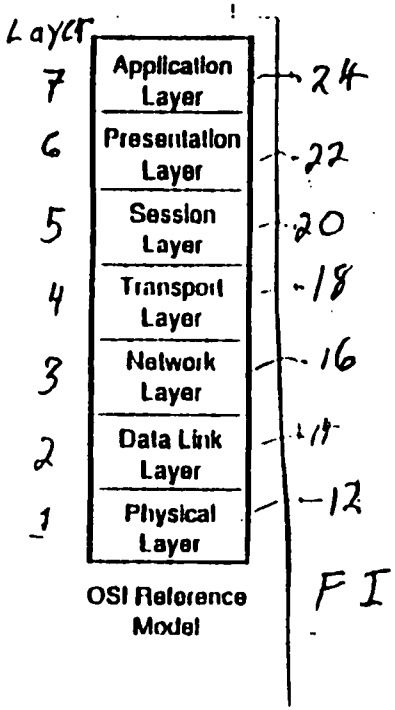

FIG. 1

LAN
- AppleTalk
- Net Bios
- Net Beau
- IPX/SPX (Novell)
- Vines/IP
- TCP/IP

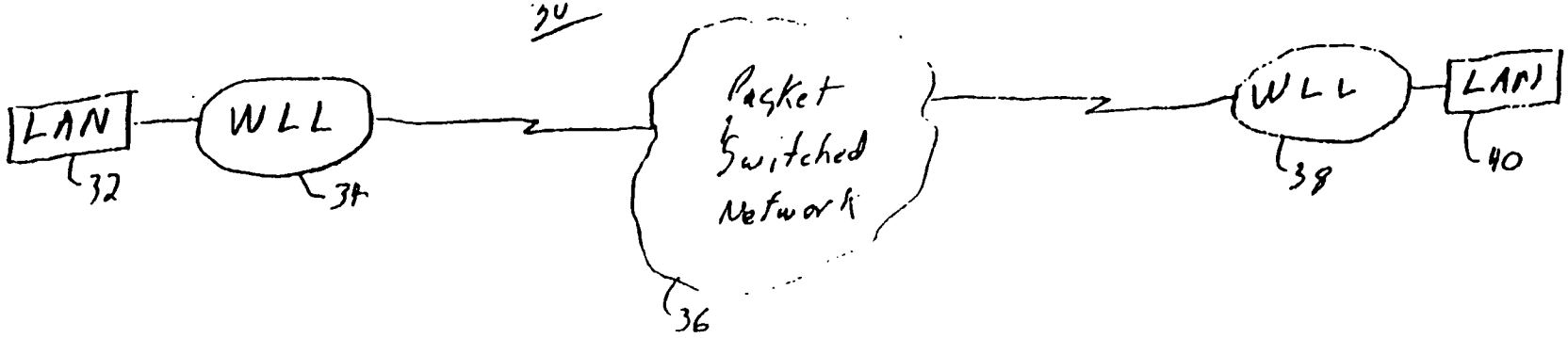

FIG. 2

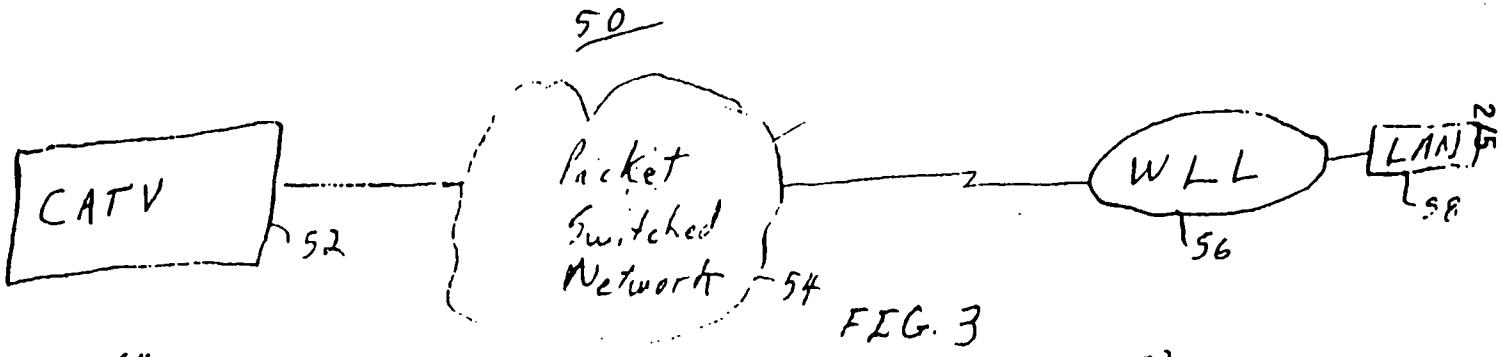

FIG. 3

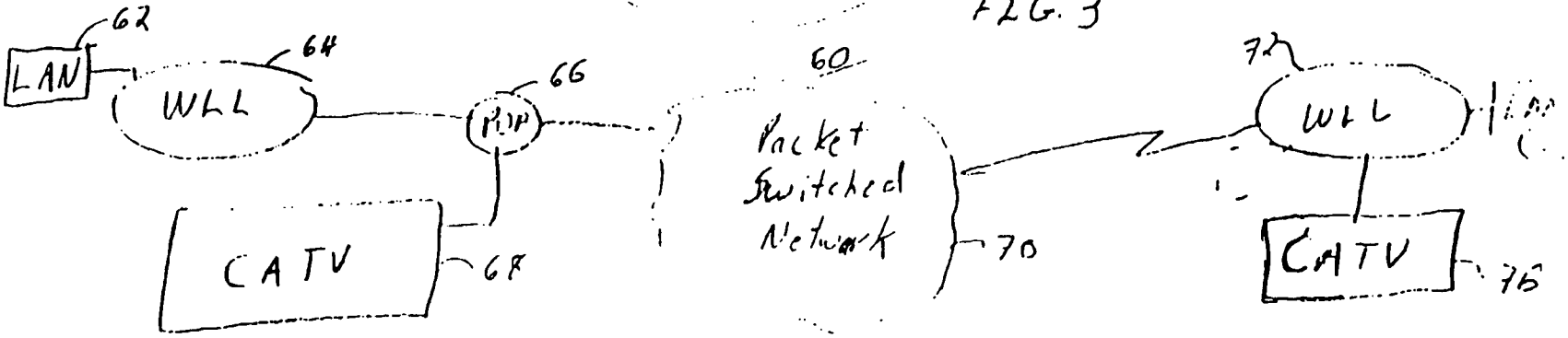

FIG. 4

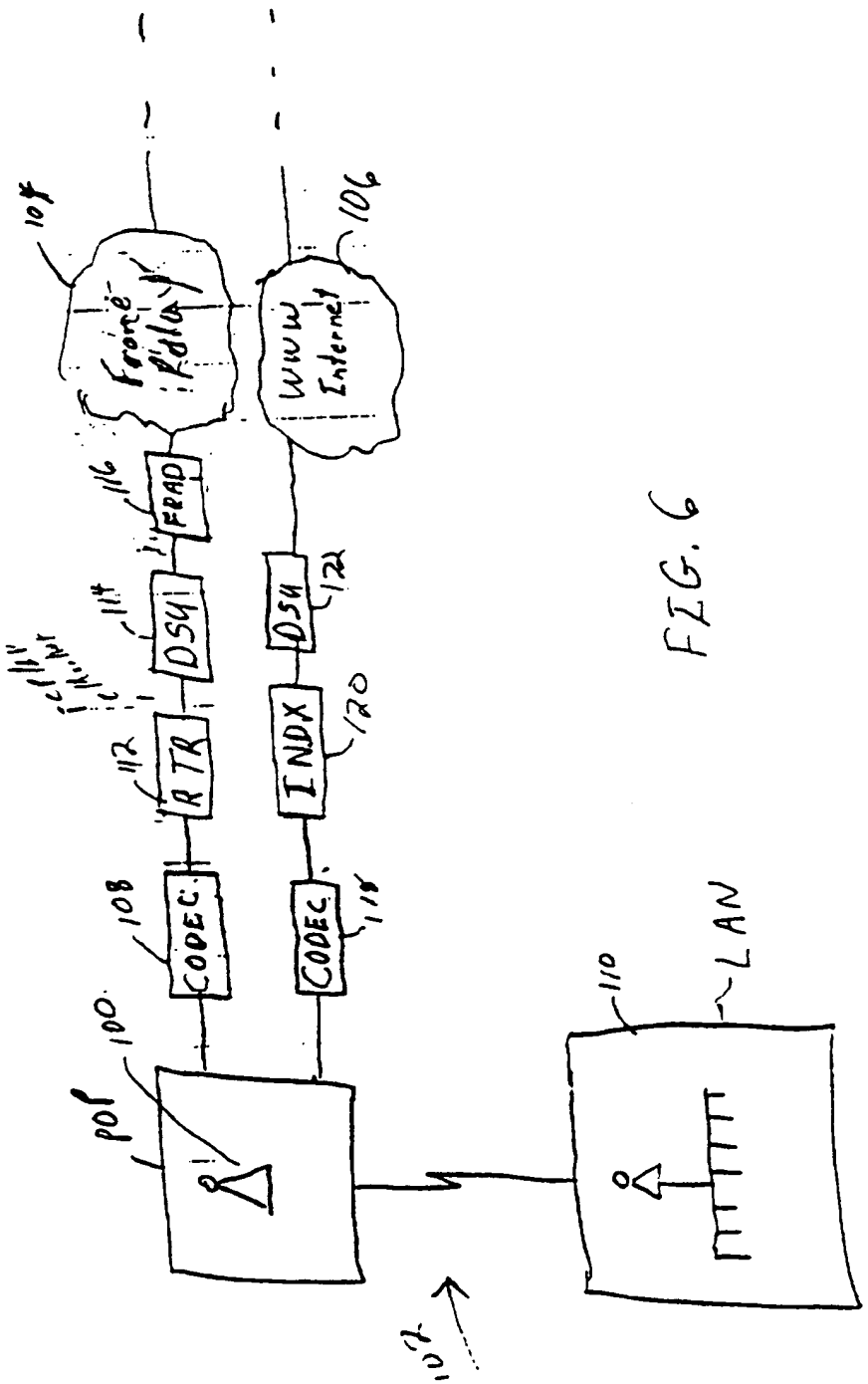
Frame Relay
WWW Internet
FRAD
DSU
DSU
RTR
INDX
CODEC
CODEC
LAN

FIG. 6

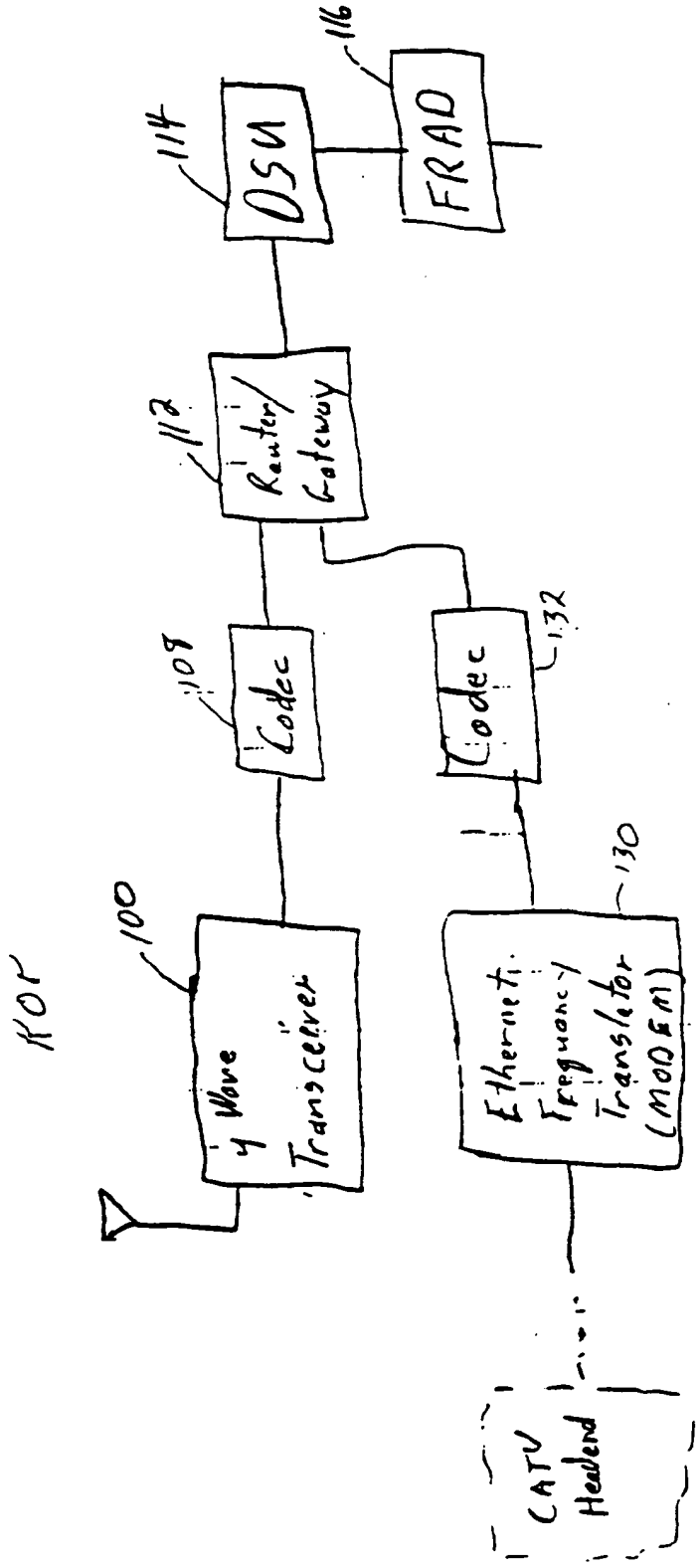
ROT
100
4 Wire Transceiver
108
Codec
112
Router/ Gateway
114
DSU
116
FRAD
132
Codec
130
Ethernet Frequency Translator (MODEM)
CATV Headend

FIG. 7

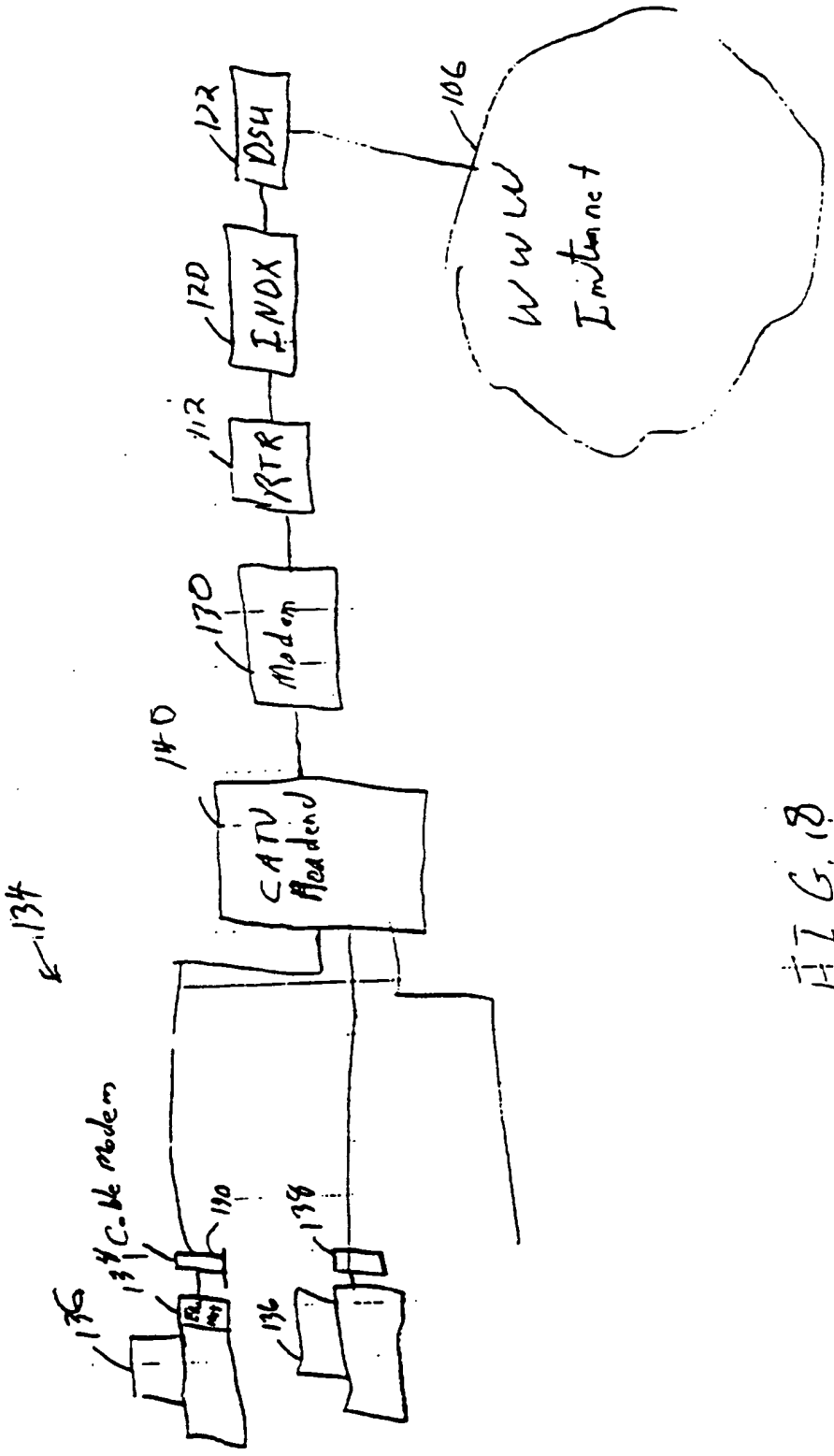
134
CATV Headend
140
Modem
170
IRTR
112
ENDX
120
DSU
122
106
WWW Internet
C. Mc modem
132
110
139
136
126

FIG. 1B

INTERNATIONAL SEARCH REPORT

In[illegible]ational application No.
[illegible]US96/15598

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04J 3/02
US CL :370/85.13, 60, 85.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/85.13, 60, 85.1, 85.2, 85.3, 85.15, 95.3, 94.1, 79, 58.3, 54, 13.1, 58.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS (local area network (LAN), wireless local loop (WLL), packet network, TCP/IP, ethernet, T1/E1 channel, CODEC, data communications network)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,351,237 (SHINOHARA ET AL) 27 September 1994, Fig. 2; col. 3, line 67 to col. 4, line 46; col. 5, lines 32-46.	8-11, 15, 17, 21-24
Y,P	US, A, 5,521,914 (MAVRAGANIS ET AL) 28 May 1996, Fig 2, 3; col. 4, lines 3-49.	9-11, 24, 25
A,P	US, A, 5,463,623 (GRIMES ET AL) 31 October 1995, Figs. 1-3.	1-15, 19-28
Y	US, A, 5,519,705 (FUKUTOMI) 21 May 1996, Fig. 4; col. 4, lines 33-40; col. 5, line 40 to col. 6, line 56.	8-11, 15-18, 21-24
Y	US, A, 5,410,754 (KLOTZBACH ET AL) 25 April 1995, col. 3, line 62 to col. 4, line 54.	1-15, 19-27
A	US, A, 5,379,290 (KLEIJNE) 03 January 1995.	1, 19

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
08 NOVEMBER 1996	13 DEC 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MELISSA KAY CARMAN BRIAN A. HARDEN PARALEGAL SPECIALIST GROUP 2400 Telephone No. (703) 308-7605

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

In...ational application No.
...T/US96/15598

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US, A, 5,517,620 (HASHIMOTO ET AL) 14 May 1996, Fig. 1; col. 3, line 49 to col. 4, line 11; col. 4, lines 36-46.	8-11, 15-18, 21-24
A	US, A, 5,347,516 (YOSHIDA) 13 September 1994.	1, 16, 19